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A NEW CRAWFISH OF THE GENUS *ORCONECTES* FROM EASTERN NEW YORK (DECAPODA: CAMBARIDAE)

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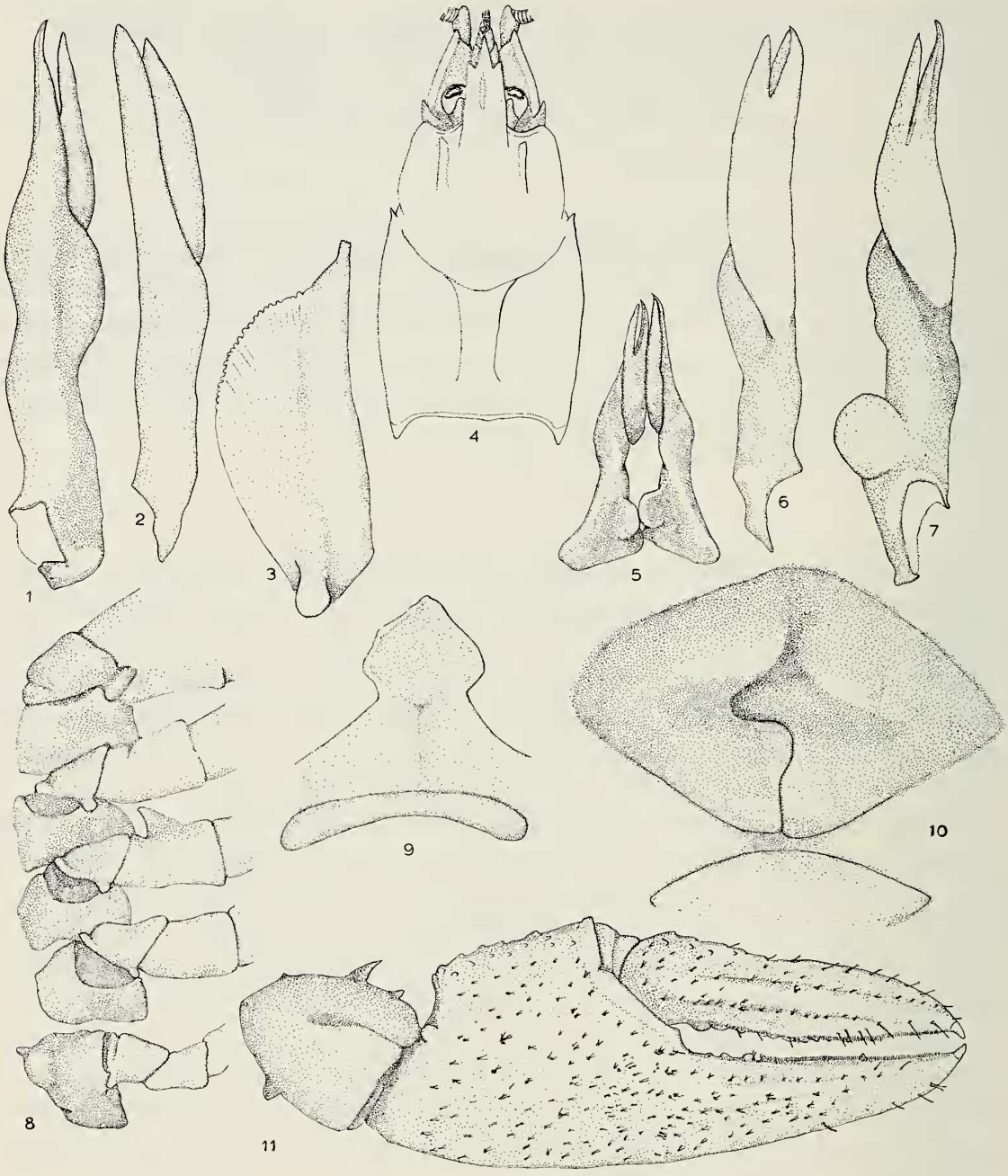
Abstract.—A new crawfish, *Orconectes kinderhookensis,* is described from Columbia and Rensselaer counties, New York. It is closely related to *O. propinquus* (Girard) and may be distinguished from it in that the mesial process of the first form male is markedly shorter than the central projection; the annulus ventralis of the female is also more sculptured. The distribution of the new species appears quite restricted.

The last comprehensive account of the New York crawfishes (Crocker, 1957) listed five species of the genus *Orconectes*: *O. immunis* (Hagen, 1870), *O. limosus* (Rafinesque, 1817), *O. obscurus* (Hagen, 1870), *O. propinquus* (Girard, 1952) and *O. virilis* (Hagen, 1870). These represent three remotely related groups. All but *O. obscurus* are represented in the drainages of the east bank of the Hudson River, but *O. propinquus* of this area was restricted to the "northern Hudson River" by Fitzpatrick (1967:146).

Recent collections in Kinderhook Creek in Columbia and Rensselaer counties indicated that four species of *Orconectes* inhabit the creek: *O. limosus, O. virilis, O. propinquus* and a species closely related to the latter but yet undescribed (Smith, 1979; JFP, personal collections). Surrounding stream systems are populated by *O. propinquus,* but in Kinderhook Creek, the populations of *propinquus* are scattered, restricted and entirely surrounded by populations of the undescribed species. The stream is an excellent fishing creek, supporting good populations of trout, largemouth and smallmouth bass, and other attractive fish. One is led to speculate, then, that one species is the native one, and that the other populations represent successful introductions by fishermen.

Crocker (1957:76) mentions that USNM no. 74712 is a collection of *O. obscurus* from the creek. We have examined this collection (Kinderhook Ck at Kinderhook, Rensselaer Co, NY, 5 ♂II, 31 Aug 1934, Townes and Nevin, collectors) and four of the specimens are *O. limosus* and the fifth is a member of the species described below. (W. L. Schmitt had identified it as *obscurus,* but the container has a note, initialled by Crocker and dated July, 1951, identifying the specimens as "Orconectes sp.") On page 77 he gave another Kinderhook Creek locality (DWC-132, now at USNM; Kinderhook Creek at crossing of Rte 9, between the towns of Valatie and Kin-



Figures 1–11 (All of holotype, unless otherwise noted). **1,** lateral view of first pleopod; **2,** lateral view of first pleopod of morphotype; **3,** antennal scale; **4,** dorsal view of carapace; **5,** caudal view of first pleopods; **6,** mesial view of first pleopod of morphotype; **7,** mesial view of first pleopod; **8,** basal podomeres of pereiopods; **9,** epistomal region; **10,** annulus ventralis of allotype; **11,** distal podomeres of cheliped.

derhook, 3 ♂II, 1 j♀, 1 July 1951, J. A. Gustafson and Earl Deubler, Jr., collectors). This collection has also been examined and we concur with his identification of these specimens as *O. limosus*. Smith (1979:134) reported *O. propinquus* from the creek in Nassau Township, Rensselaer County; we have seen these specimens and agree with his identification.

Orconectes kinderhookensis, new species
Figs. 1–11

Orconectes obscurus.—Crocker, 1957:76 [in part; see above].

Diagnosis.—Pigmented; eyes normal. Rostrum with margins slightly converging cephalically, sometimes subparallel, terminating in small acute spines; acumen prominent but not bearing median carina found on rostrum. Areola 29.51–36.10 (avg. 32.64) percent of entire length of carapace and 2.05–5.88 (avg. 4.15) times as long as wide, with 3–6 punctations in narrowest part. Cervical spines present, occasionally one bifid, but never paired on one side. Postorbital ridges strong, grooved dorsolaterally and terminating cephalically in acute spines. Branchiostegal spine small, but distinct and acute. Postorbital angle absent or very obtuse. Antennal scale broadest slightly distal to mid-length and 2.20–2.63 (avg. 2.43) times as long as wide. Ischia of only third pereiopods of male with hooks; coxa of fifth pereiopod with nearly tuberculiform, longitudinally-oriented boss. First pleopods of male symmetrical, terminating distally in two straight, subparallel parts; central projection of first form male 20.43–29.54 (avg. 25.40) percent of length of pleopod and of second form male 13.00–18.00 (avg. 15.77); mesial process shorter, in Form I males 78.57–89.06 (avg. 85.37) percent of length of central projection, in Form II males 68.97–84.85 (avg. 78.78); pleopod length divisible into carapace 2.84–3.17 (avg. 3.00) times for Form I males and 2.72–3.29 (avg. 3.06) for Form II males; central projection slender with acute tip curved slightly caudad; mesial process subsetiform and always terminating in very acute tip. Annulus ventralis immovable, subrhomboid in outline with conspicuous submedian longitudinal sulcus, prominent transverse trough in central part and sinus arising laterally in anterior region of trough curving and recurving before bisecting caudal third of annulus to margin.

Holotypic male, Form I.—Body pigmented, somewhat depressed, slightly compressed laterally (Fig. 4); eyes normal. Carapace punctate over most of surface but low squamous tubercles in extreme cephalolateral hepatic region of branchiostegite. Abdomen longer than cephalothorax (20.9 and 19.7 mm, respectively); carapace width greater than depth at level of caudodorsal margin of cervical groove (9.1 and 8.7 mm). Rostrum with moderately thick-

ened margins, flanked medially by irregular row of setiferous punctations, slightly converging cephalically and terminating in acute spines, prominent carina in midcephalic half; acumen distinctly delineated basally and tip broken, but clearly upturned. Suborbital angle obsolete; branchiostegal spine strong and acute. Postorbital ridges well developed and terminating cephalically in spinose tubercles; cervical spine present. Areola 30.46 percent of entire length of carapace, 4.0 times as long as wide and with 4–5 punctations across narrowest part. Telson with two spines in each caudolateral corner of cephalic half; usual transverse sutures present. Proximal podomere of uropod with two prominent acute spines distally; inner ramus with strong spine in caudolateral corner and strong acute spine arising on dorsal mediodistal surface, neither spine overreaching distal margin of ramus; outer ramus with usual row of small subequal acute spines along distal margin of proximal element. Pleuron of second abdominal segment expanded cephalically, but remaining segments with subrectangular pleura. Lateral margins of thoracic sternites with moderately dense long setae not obscuring pleopods. Cephalic portion of epistome (Fig. 9) broadly subtriangular, without strongly developed marginal ridges or cephalomedian projection, surface nearly planar; main body with scarcely perceptible fovea in anterior portion of longitudinal bisecting furrow; epistomal zygoma very gently arched and without evident cephalolateral flanking pits. No rows of dense setae associated with maxillae or maxillipeds.

Chela (Fig. 11) somewhat depressed, 2.46 times as long as wide and with mesial margin of palm 33.33 percent of entire length of propodus; mesial margin of palm with row of 8 squamous tubercles, flanked dorsally by irregular rows of 6 and 2 and ventrally by irregular row of 4 (left chela with rows, in the same sequence, of 9, 7, 0, and 1); upper and lower surface of palm with setiferous punctations, moderately numerous, evenly distributed; lateral margin of palm not keeled. Opposable margin of fixed finger with row of three tubercles, increasing in size distally, in basal fourth, followed distally by relatively broad single band of crowded minute denticles, latter interrupted by tubercle at midlength, extending from third tubercle nearly to corneous tip of finger; finger with weak median longitudinal ridge above and below, ridge flanked mesially by row of small setiferous punctations through most of its length. Dactyl with double row of 9–10 tubercles, decreasing in size distally, along basal one-third of mesial margin; longitudinal ridges above and below only slightly more developed than those on immovable finger; opposable margin with row of 10 tubercles, decreasing in size distally, along basal two-thirds, last 5 interrupting row of crowded minute denticles extending along distal two-thirds of finger in form comparable with that on opposing finger.

Carpus punctate above, sparsely so below; mesial margin with strong acute spine at midlength and second strong spine in distomesial corner;

shallow longitudinal trough in middle half of central dorsal surface; lower laterodistal corner with strong acute spine, lower mesiodistal corner entire. Merus sparsely punctate on all surfaces; dorsal surface with strong acute spine on distomedian surface; ventral mesiodistal and laterodistal corners each with prominent articulating tubercle subtended by strong acute spine below; ventromesial margin with row of 8 squamous tubercles and ventrolateral margin unadorned except for strong acute spine at distal end. Remaining podomeres with punctate surfaces, otherwise not unusual; prominent suflamen on basis.

Hooks on ischium of third pereiopods only (Fig. 8); hooks simple and overhanging corresponding basis, but without opposing tubercle on basis. Only coxa of fifth pereiopod with boss; boss almost tuberculiform and oriented longitudinally.

First pleopods (Figs. 1, 5, 7) as described in "Diagnosis"; central projection corneous. Pleopods reaching cephalic margins of coxae of third pereiopod when abdomen flexed.

Allotypic female.—Except for secondary sex characteristics and proportions (see Variations and Comparisons), differing from holotype in following respects: postorbital ridges terminating cephalically in strong, acute spines. Mesial margin of right palm with row of 8 tubercles mesially, but flanked dorsally by only single row of 5 and ventrally by row of 2; mesial margin of left with row of 9, flanked dorsally by rows of 5 and 3 and ventrally by no tubercles. Opposable margin of fixed finger with row of 5 tubercles in basal half and narrower row of crowded minute denticles along distal one-third; opposable margin of movable finger with 6 subequal tubercles and slightly longer, equally narrow row of denticles than that on immovable finger.

Annulus ventralis (Fig. 10) subrhomboid in outline, immovable, fused with antecedent sternite. Surface contoured with submedian sulcus in cephalic fourth and transverse trough, latter two-thirds width of entire annulus; sinus originating in deep trough at caudodextral end of sulcus, moving nearly transversely to midline and from there winding sinuously to caudal margin; prominent dextrally directed tongue just cephalic to sinus; sperm plug (not illustrated) present. Postannular sternite spindle-shaped, highest in center and slightly more than half as wide as annulus.

Morphotypic male, Form II.—Except for reproductively cyclic characters and proportions (see Variations and Comparisons) differing from holotype in following respects: postorbital ridges terminating cephalically in strong, acute spines. Mesial margin of right palm with row of 9 tubercles, rows of 3 and 6 dorsally and of 2 ventrally; left with rows of 8, 3, 6 and 1, respectively. Opposable margin of dactyl with row of 5 tubercles and row of crowded minute denticles intermediate in width between that of holotype and allotype, along distal four-fifths; similar row of denticles along distal two-

Table 1.—Measurements of types of *Orconectes kinderhookensis*, in mm.

	Holotype	Allotype	Morphotype
Carapace			
length	19.7	21.6	19.7
width	9.1	9.8	8.8
height	8.7	10.0	7.9
Rostrum			
length	6.1	6.4	5.7
width	2.8	3.2	3.1
Acumen			
length	1.5	2.1	1.9
Antennal scale			
length	4.0	4.7	4.4
width	1.8	2.3	2.0
Areola			
length	6.0	6.6	6.2
width	1.5	1.6	1.5
Abdomen			
length	20.9	19.2	22.6
width	8.5	8.6	10.8
Chela			
total length	15.0	12.0	12.8
width of palm	6.1	5.7	5.2
length of inner margin of palm	5.0	4.2	4.1
length of dactyl	9.2	7.6	7.4

thirds of opposable margin of fixed finger. Hooks on ischia of third pereiopods less well developed, but still distinct; bosses on coxae of fifth pereiopods nearly as well developed. Terminal elements of first pleopod (Figs. 2, 6) both non-corneous and more blunt than those of holotype; no evidence of juvenile suture.

Type-locality.—Kinderhook Creek, 0.4 mi (0.6 km) S of the Rensselaer County line on State Route 66, directly opposite Tennessee Gas Pipeline Compressor Station No. 254, Columbia County, New York.

Disposition of types.—The holotypic male, Form I, the allotypic female, and the morphotypic male, Form II, are in the National Museum of Natural History, Smithsonian Institution, nos. 148883, 148884, and 148885, respectively. Paratypes from Columbia Co. (17 ♂I, 6 ♂II, 23 ♀) and Rensselaer Co. (3 ♂I, 1 ♂II) are deposited in the same repository and another set is in the collection of the junior author.

Variations and comparisons with O. propinquus.—Based on the specimens at our disposal, *Orconectes kinderhookensis* is a morphologically very

Table 2.—Descriptive statistics for certain characters in *O. kinderhookensis* and sympatric *O. propinquus*.

Characteristic	*O. propinquus*			*O. kinderhookensis*		
	Mean	Vari-ance	Range	Mean	Vari-ance	Range
♂ I Carapace length	24.80	3.68	16.0–31.9	20.21	1.59	18.3–22.7
♂ II Carapace length	19.21	2.22	15.8–22.1	18.43	0.49	17.8–18.2
♀ Carapace length	23.34	4.99	16.4–33.2	23.20	4.80	18.8–32.5
♂ Antennal scale length	2.32	0.27	1.92–3.13	2.43	0.13	2.20–2.63
♀ Antennal scale length	2.45	0.25	2.16–2.94	2.63	0.23	1.90–2.78
Areola length (as % carapace length)	31.82	1.37	27.87–34.15	32.64	1.40	29.51–36.10
Areola length:width	4.19	0.62	3.40–5.50	4.15	1.03	2.05–5.88
♂ I Carapace length:pleopod length	3.24	0.28	2.81–3.75	3.00	0.10	2.84–3.17
♂ II Carapace length:pleopod length	3.06	0.19	2.72–3.29	3.22	0.05	3.15–3.27
♂ I central projection length (as % length pleopod)	24.50	4.38	19.85–33.33	25.40	2.58	20.43–29.54
♂ II Central projection length (as % length pleopod)	13.97	1.03	12.41–15.91	15.77	2.11	13.00–18.00
♂ I mesial process (as % length central projection)	98.21	2.57	93.18–104.69	85.37	3.52	78.57–89.06
♂ II mesial process (as % length central projection)	91.75	7.88	84.00–106.90	78.78	7.48	68.97–84.85

stable species. Each specimen was subjected to 14 measurements: (1) carapace length, (2) carapace width, (3) carapace height, (4) rostrum length, (5) rostrum width, (6) acumen length, (7) antennal scale length, (8) antennal scale width, (9) areola length, (10) areola width, (11) chela length, (12) palm width, (13) length of inner margin of palm, and (14) dactyl length; males were subjected to three additional measurements: (15) pleopod length, (16) central projection length and (17) mesial process length. Discriminate analysis indicated that the populations were distinct from *O. propinquus* ($F = 3.2436$, with 17 and 44 df; Mahalanobis $D^2 = 5.89$). These measurements were then compared using covariance analysis for sexual differences and for differences between the two species. Descriptive statistics were computed for areola length (as percent length of carapace), areola length:width, antennal scale length:width, carapace length:male pleopod length, central projection length (as percent length of pleopod) and central projection length:mesial process length. Meristic data were accumulated on (1) punctations across the narrowest part of the areola, (2) ornamentation of the mesial margin of the palm, (3) of the mesial surface of the merus, and (4) of the distal lower lateral and (5) distal lower mesial corners of the merus; data were recorded on (1) cervical spination, (2) marginal spines of the

rostrum, (3) margins of the rostrum, (4) carina of the rostrum, (5) in males the development of ischial hooks and (6) in females the presence of a sperm plug. Where appropriate, frequencies were compared, using the G-test.

Sexual dimorphism was found in *O. kinderhookensis* in female carapace width ($P \geq 0.05$), antennal scale width, and chela length; in *O. propinquus* sexual dimorphism was noted in antennal scale width, chela length, length of the inner margin of the palm and number of punctations in the areola. This latter surprised us, but in males, 70 percent of the specimens have areolae with 2–4 punctations, while in females 89 percent of the specimens have 4–6. Significant differences between the two species were found in female carapace width, antennal scale width, areola width, dactyl length of male chela, and length of the mesial process.

Descriptive statistics are given in Table 2.

Among meristic data, differences in punctations across the narrowest part of the areola are noted, but other data proved not significantly different. Probably the most variable characteristic seen in *O. kinderhookensis* was in the tuberculation along the mesial margin of the palm. Basically, four very irregular rows of tubercles can be found in the species. The mesialmost varied from 2–8 in number with 2 and 5 being the most commonly occurring counts. Ventral to this row there usually are no tubercles, but a row up to 5 may be encountered. Two dorsal rows may occur, a more mesial one of 2 or 5 (sometimes absent) and a more dorsal row of 2–8, with seven the most common count. Because of the extreme irregularity of the rows, assignment to a specific row is often difficult, but, in males, the total number of mesially placed tubercles varies from 12–24, with the most common number being 15; in females the numbers are 15–21, usually 18, and statistically there is no sexual dimorphism. When compared with *O. propinquus* in a G-test, however, first form males differed significantly in the total number of tubercles, *O. propinquus* varying 13–24 with the most usual count being 18.

The rostral margins were parallel in 24.49 percent of the specimens of *O. kinderhookensis* and gently converging cephalically in 73.47 percent. This compared with equivalent figures of 32.14 percent and 67.86 percent for *O. propinquus*, but they were not statistically different.

All first form males had well developed hooks on the ischia of the third pereiopods and nowhere else. In second form males of both species hooks varied from tubercular knobs to rudimentary tubercles, apparently directly correlated with size of individuals. These hooks, too, showed no evidence of development except on the third pereiopod.

As collections were made only from mid-August to mid-September and early November, little can be said of the life history. Form I males and females with a sperm plug in the annulus ventralis were captured in all periods. Evidence for Fall breeding exists in sperm plug data, however. In

November collections 60 percent of the females had a sperm plug, compared with 20 percent in the earlier collections.

The largest female possessed a 33.2 mm carapace length and did not have a plug; the corresponding length of the smallest with a plug was 19.1 mm. Those of the largest and smallest first form males were 31.9 and 16.0 mm, respectively, and of the largest second form male, 22.1 mm. All of these values fit comfortably into the size distributions for *O. propinquus*.

Remarks and relationships.—Orconectes kinderhookensis is most closely related to *O. propinquus* and is assigned to the Propinquus Subgroup, Propinquus Group of the Propinquus Section of the genus. It may be distinguished from *O. propinquus* in that the terminal rami of the first pleopod of first form males are decidedly unequal in length; in females the annulus is much more sculptured, the transverse trough, anterior sulcus, and prominent tongue being much more evident than seen in *propinquus*. The most significant feature, however, which indicates that the two are discrete species is the fact that they occur together in the stream without apparent interbreeding.

More difficult than demonstrating their separation is explaining it. Kinderhook Creek, or a part of it, could not have served as a glacial refugium. All surrounding related populations in the creek are clearly assignable to *O. propinquus*. Subsequent to the preparation of this manuscript Dr. D. G. Smith (personal communication) wrote that he had collected specimens resembling *O. kinderhookensis* from sites in the Housatonic River system. Thus, the question of the species' emergence becomes more enigmatic.

One cannot help but notice, however, that both upstream and downstream other species of *Orconectes* replace Propinquus Section crawfishes. Bovbjerg (1961) has demonstrated the vigor of *O. virilis* as a competitor; perhaps *O. limosus* is equally strong, or at least more competitive than Propinquus stock. It is not, however, as competitive as *O. virilis* under certain environmental conditions (Schwartz et al., 1963). An early isolation of some *propinquus*-like populations in Kinderhook Creek or similar waters by headwaters and mouth invasions by more vigorous species could have allowed divergence of a small population by genetic drift. When the two populations, parental and descendant, reunited, possibly by introduction of the former, they were unable to interbreed. This thesis is supported by the apparent dominance of *O. kinderhookensis* over *O. propinquus* where they occur contiguously in the creek. More dominant individuals would have been favored in competition with species possessing high dominance potentials. Penn and Fitzpatrick (1962; 1963) have reported the results of some experiments to test such an hypothesis with respect to range changes occurring in some species of *Cambarellus*. This simplistic thesis must be accepted *cum grano salis* until more detailed information is acquired by scholars on the site.

Literature Cited

Bovbjerg, R. V. 1961. Mechanisms isolating two species of crayfish.—Amer. Zool. 1:345.

Crocker, D. W. 1957. The crayfishes of New York State (Decapoda, Astacidae).—New York St. Mus. Sci. Serv. Bull. 355:97 p.

Fitzpatrick, J. F., Jr. 1967. The Propinquus Group of the crawfish genus *Orconectes* (Decapoda: Astacidae).—Ohio J. Sci. 67:129–172.

Girard, C. 1852. A revision of the North American Astaci, with observations on their habits and geographical distribution.—Proc. Acad. Nat. Sci. Philadelphia 6:87–91.

Hagen, H. A. 1870. Monograph of the North American Astacidae.—Illus. Cat. Mus. Comp. Zool., Harvard Coll. 3:viii + 109 p.

Penn, G. H., and J. F. Fitzpatrick, Jr. 1962. Interspecific competition between crawfishes.—Amer. Zool. 2:436.

Penn, G. H., and J. F. Fitzpatrick, Jr. 1963. Interspecific competition between two sympatric species of dwarf crawfishes.—Ecology 44:793–797.

Rafinesque, S. C. 1817. Synopsis of four new genera and ten new species of Crustacea, found in the United States.—Amer. Mon. Mag. Crit. Rev. 2:40–43.

Schwartz, F. J., R. Rubelmann, and J. Allison. 1963. Ecological population expansion of the introduced crayfish, *Orconectes virilis*.—Ohio J. Sci. 63:266–273.

Smith, D. G. 1979. New locality records of crayfishes from the middle Hudson River system.—Ohio J. Sci. 79:133–135.

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